A.D. 1793 . . . . N° 1950.

SPECIFICATION

OF

JOHN DALE.

GENERATING AND APPLYING STEAM.

LONDON:
PRINTED BY GEORGE E. EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY:
PUBLISHED AT THE QUEEN'S PRINTING OFFICE, EAST HARDING STREET,
NEAR FLEET STREET.
Price 2d. 1854.

A.D. 1793 . . . . Nº 1950.

Generating and Applying Steam.

DALE'S SPECIFICATION.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, John Dale, of Leominster, in the County of Hereford, Engineer, send greeting.

WHEREAS His most Excellent Majesty King George the Third did, by His Royal Letters Patent, under the Great Seal of Great Britain, bearing date at Westminster, the Eighteenth day of April, in the thirty-third year of His reign, give and grant unto me, the said John Dale, His special licence, full power, sole privilege, and authority, that I, the said John Dale, during the term of years therein expressed, should and lawfully might make, use, exercise, and vend, within England, Wales, and the Town of Berwick upon Tweed, my Invention of "Modes of Conducting Steam, and likewise of Generating Steam, whereby great Advantages would arise in the Saving of Fuel by applying of those new invented Principles to Steam Engines or other Machines that have similar Properties, which Invention would prove of the greatest utility to the public;" in which said Letters Patent there is contained a proviso obliging me, the said John Dale, by an instrument in writing under my hand and seal, to particularly describe and ascertain the nature of my Invention, and in what manner the same is to be performed, and cause the same to be inrolled in His Majesty's High Court of Chancery within three calendar months next and immediately after the date of the said Letters Patent, as in and by the said Letters Patent, reference being thereunto had, may more fully and at large appear.

NOW KNOW YE, that in compliance with the said proviso, I, the said John Dale, do hereby declare that the nature of my said Invention, and the manner in which the same is to be performed, is particularly described and ascertained by the plan hereunto annexed and as follows (that is to say):—

My new Invention consists in employing the elastic power of steam to make a given measure or a cylinder full of the said steam to enter the cylinders or steam vessels, one after another, any number of them, and to press the pistons, or whatever may be used instead of them, a certain number of times either against a vacuum made in the cylindrical or other cavity on the contrary side of the said pistons and during the time of the stroke, or against a constant vacuum on the other side the pistons, or against the counteracting pressure of air or steam contained in the said cylindrical cavity on the other side the said pistons. In applying the steam according to these principles I employ any number of the cylinders or steam vessels. These I call my first, second, third, fourth, or fifth cylinders or steam vessels, or the sixth, seventh, or eighth *c, t,* to the greatest number of cylinders employed, and are so called from the order in which they receive the said measure or the cylinder full of steam to be employed in that cylinder for giving additional power to the engine.

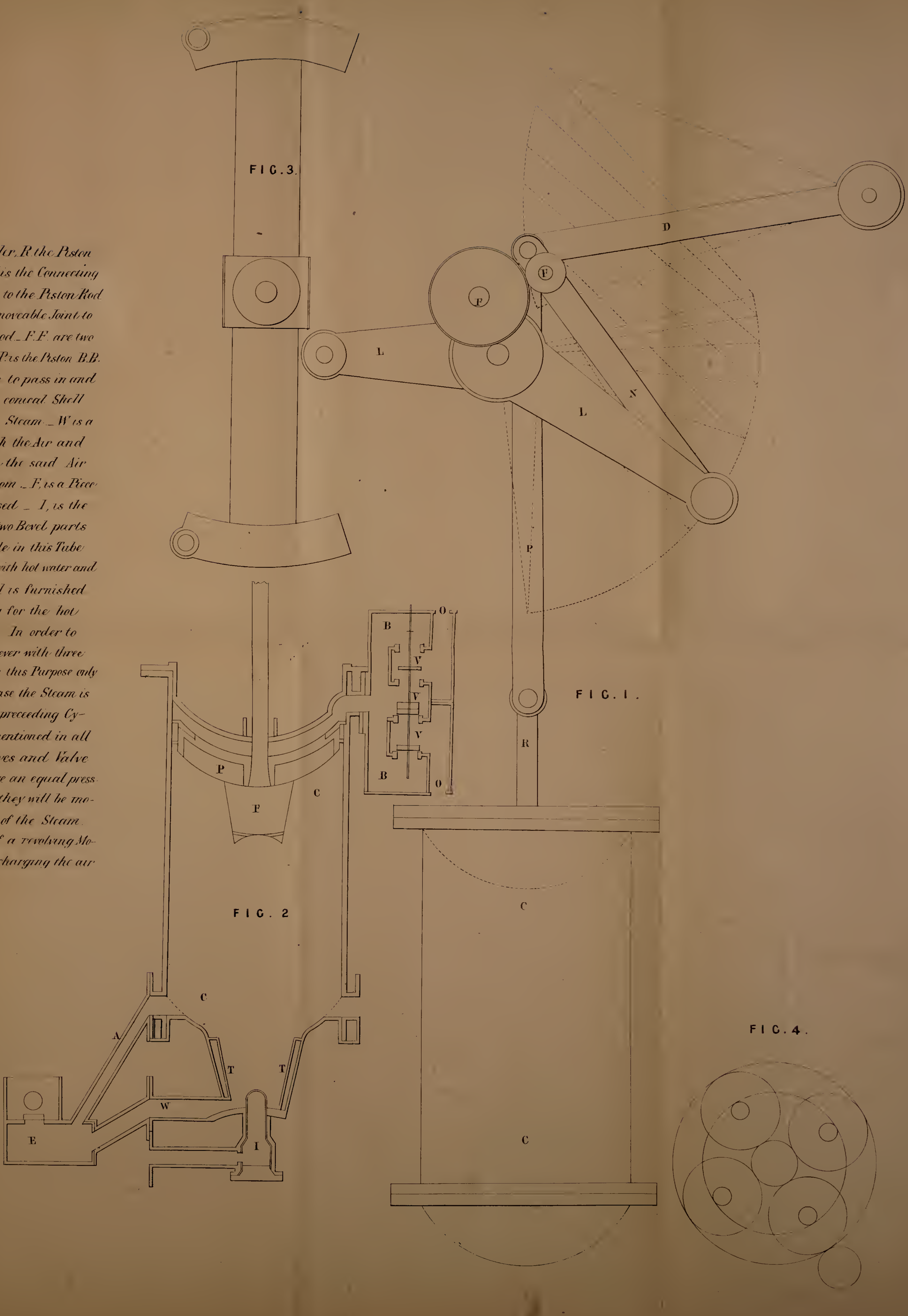
In these cases I employ three, four, five, or six, or any other number to ten or twenty cylinders, or any greater number of these cylinders or steam vessels; and with respect to the comparative dimensions of the cylinders, the precedent and succedent cylinders are in many cases of such proportions in their relative bulk that the dimensions of the succedent cylinders will exceed that of the next precedent cylinder two, three, or six or twelve times, or a greater number of times; or the precedent and next succedent cylinders may in some cases be employed of an equal bulk; and in other cases, with some of the cylinders, the precedent can be made to exceed the next succedent cylinder in its dimensions, and they may be employed of any intermediate proportion that can be taken between the aforesaid proportions of the cylinders' dimensions. For applying the steam in the first case the said steam is conveyed from the boiler or vessel in which it is generated, and made to enter the first cylinder or steam vessel, and it there presses the piston with its whole force against a vacuum that is made on the other side of the said piston, and in some cases against expanded steam that is contained on the other side the piston, and which has a considerably less degree of elastic power than that which makes the stroke by its pressure on the contrary side of the piston. When this first cylinder is filled with steam, and the piston is arrived at the end of his stroke, I shut off the communication between the said first cylinder and the boiler, and open a communication between the first and second cylinders, and this steam is then conducted into the second cylinder and is dilated, and presses the second cylinder piston with the whole force that arrives from its elastic power against a vacuum or a considerably dilated steam on the other side of the said piston; at the same time there is opened a communication between the cylindrical or other cavities separated by the piston in the first cylinder, and thereby an equal pressure of steam is made on both sides the said piston, and therefore this piston returns back in equilibrio at the time that the second cylinder piston is making his stroke, and when the said stroke is compleated, and likewise the first cylinder piston returned back by the steam balance, I shut off the communication between the first and second cylinders and that between the two cylindrical cavities made separate by the piston in the first cylinder, and again open the communication between the boiler and the first cylinder for repeating the aforesaid process. At the same time a communication is opened between the second and third cylinders, and this steam is then conducted into the third cylinder and is further dilated, and presses the third cylinder piston, by means of its elastic power, against a vacuum or a much expanded steam on the other side of the said third cylinder piston. The said expanded steam on the other side the said piston is that which remains at the return of the piston from making the aforesaid equal pressure of steam on both sides the pistons, which steam, instead of being condensed, is admitted into the succeeding cylinders or into the next cylinder except one, and again presses the pistons against a vacuum or a more dilated steam on the other side the piston; but it is this small part only of the steam which is condensed for making the vacuum in the cylinders after the piston in each cylinder has made his stroke and has returned back again, in case the pistons are pressed against a vacuum. And in case they are pressed against the expanded steam no condensation will be made to precede the stroke of the piston in those cylinders, and this may be the case with only some few of the cylinders, or the condensation may not be made in any of the said cylinders excepting in the last cylinder and preceding the stroke in that cylinder, but in all these cases much the greatest part of the steam will remain uncondensed till the last cylinder piston has made his stroke. To peruse the process further with additional cylinders, I open a communication between the cylindrical or other cavities separated by the piston in the second cylinder, and thereby make an equal pressure of steam on both sides the said piston, and by this means the said second cylinder piston returns back in equilibrio or by the steam balance, and this return will be made whilst the third cylinder piston is making his stroke; and when this stroke is completed, and the said return of the other piston is made by the said steam balance, I shut off the communication between the second and third cylinders and that which is between the cylindrical cavities, separated by the piston in the second cylinder, and again open the communication between the first and second cylinders for repeating the process; and at the same time a communication is opened between the third and fourth cylinders. This steam is then conducted into the fourth cylinder and is still further dilated, and presses the fourth cylinder piston, by its elastic power, against a vacuum made on the other side of the said piston, and at the same time there is opened a communication between the cylindrical or other cavities separated by the piston in the third cylinder, and thereby admits the steam to produce an equilibrio or steam balance, whilst the third cylinder piston returns back again; both pistons or all of them being arrived at the end, I shutt off the communication between the third and fourth cylinders and that between the cylindrical cavities in the third cylinder, and again open a communication between the second and third cylinders. In order to repeat the process, a communication is at the same time opened between the fourth and fifth cylinders; the said steam is then conducted into the fourth cylinder, and is greatly dilated, and presses the fifth cylinder piston, by its elastic power, against a vacuum that is made on the contrary side of the piston, and there is opened a communication between the cylindrical cavities separated by the piston in the fourth cylinder, and hence the fifth cylinder piston returns back in equilibrio, whilst the fifth cylinder piston is making his stroke, which said stroke being completed, I shutt off the communication between the fourth and fifth cylinders, and likewise the communication between the cylindrical cavities made by the piston in the fourth cylinder, and again open the communication between the third and fourth cylinders for the purpose of repeating the process. And in case a greater number of cylinders are employed, the process may be further continued by opening a communication between the precedent and the next succedent cylinders; the said steam is then conducted into the said succedent cylinder, and is dilated and presses the said succedent cylinder piston, by its elastic power, against a vacuum, and in some cases against steam that is greatly expanded, and at the same time to open a communication between the cylindrical (or other) cavities separated by the piston in the said precedent cylinder, and thereby make an equal pressure of steam on both sides the said piston, by which means it returns back in equilibrio, and afterwards, by shutting off the communication between the aforesaid precedent and next succedent cylinders, and likewise the communication between the cylindrical cavities separated by the piston in the said precedent cylinder; and the mode of the operation above described may be continued to any number of cylinders by proceeding in a repetition of the said process till the stroke is compleated in the last cylinder. I then open a communication between the cylindrical cavities separated by the piston in the said last cylinder, and hence there will be an equal pressure of the greatly dilated steam, or in other cases a vacuum on both sides the said piston, and therefore the said last cylinder piston will return back in equilibrio, and the steam contained in this cylinder (or the whole of the steam admitted from the boiler into the first cylinder at each stroke) is condensed each time the said last cylinder piston makes his stroke. The steam will expand to a further repetition of the process, and a further, or until the said steam becomes too far dilated or expanded, and its elastic power so much diminished as to produce very little additional power to the engine, if continued, to repeat its action in the cylinders. On letting out the steam from a preceding, and into the next succeding cylinder, it expands to fill the cylindrical cavities left by the pistons in both cylinders; it acquires the same degree of density (very nearly) in the succeeding as that which it has at the same time in the preceding cylinder, and expands during the time that the piston is making his stroke (excepting in the first cylinder), and with the above process the steam will fill both the preceding and the succeeding cylinders as soon as the pistons are arrived at the end of their stroke. But with those cases, for which I shall next describe the process, this steam will fill only the succeding cylinder at the time that the pistons are arrived at the end of their stroke. Secondly, in the next case of applying the steam upon this principle, there is a communication opened between the boiler and the first cylinder, and the steam enters the said first cylinder and presses the piston with its full force either against a constant vacuum on the other side of the piston or against air or steam in this same cylindrical cavity on the other (or contrary) side of the said piston. When this first cylinder piston is arrived at the end of his stroke, I shutt off the communication between the first cylinder and the boiler, and open a communication between the first and second cylinders, and the steam from the first enters the second cylinder, and is dilated and presses the second cylinder piston with the whole force that arises from its elastic power against a constant vacuum, or in other cases against air or steam on the other side of the said piston, and whilst the second cylinder piston is making his stroke, as above said, the first cylinder piston returns back by the pressure of the said air or steam on the other side the piston; and in the case wherein a constant vacuum is used (instead of the said air or steam), the said piston returns back by means of its being mechanically connected with the second cylinder piston, as I have more fully explained in the foregoing cases that relates to the pressure of steam against air or steam, and in other cases against a constant vacuum on the other side the piston; the second cylinder piston having completed his stroke, and the first cylinder piston returned back, I shutt off the communication between the first and second cylinders, and again open the communication between the boiler and the first cylinder for repeating the foregoing process. At the same time, a communication is opened between the second (or precedent) cylinder and the third or next succedent cylinder, and this steam is then conducted into the third or succedent cylinder, and is further dilated and presses the piston by means of its elastic power, against a constant vacuum, or in the other cases against air or steam on the other side of the said piston, and this process may be continued as with the above to any greater number of cylinders, and in some cases I employ two or more cylinders upon the first of these principles, or that method which produces an equilibrio for the piston whilst it is returning back, and the other cylinders upon the second principle. The water or other heavy fluids may be employed with these kinds of engines for communicating the steams pressure to the pistons, and also the force upon the pistons to some other part of the engine, and likewise by observing the above description of the process for these principles which employ (as aforesaid) any number of the cylinders or steam vessels. In many cases, with this third principle which employs many cylinders, there is only a small part of the steam condensed at each stroke of the piston to make each of the said pistons press against a vacuum, yet by far the greatest part of the steam may remain, and can be employed over and over again. This is in case a constant vacuum is not employed with each cylinder, whereas with other methods of applying the steam, the said steam employed for making the stroke is wholly condensed (and discharged from the cylinder) immediately after the return of the piston back again, if not before the said return is finished. In each of these cases upon these principles, each or all of the cylinders (or steam vessels) may be placed at a convenient distance from each other, or they may be firmly fixed and closely joined or fitted to the sides or ends of each other, and in some other cases those said cylinders (or steam vessels) are immerged in a vessel or in vessels of water or other kind of fluid. The whole power of these engines, or the force against the whole number of the pistons in all the cylinders, is connected by means of rods only, or with those and direction or guide rods, or with those and levers or wheels and teeth or chains or other mechanical means of combining or uniting the force that is employed against each of the said pistons. With my mode of generating steam, the hot water employed in producing the said steam is very forcibly injected against the upper part, on the inside of the vessels wherein the steam is generated; the vessel (which may be made of copper, or other metallic substances) being near a red heat, and in a number of small jets made by the force of compresst air, a forcing pump being furnished with an air vessel and a loaded valve, that the said water, when injected, may

A.D. 1793. APRIL 18. Nº 1950.
DALE'S SPECIFICATION.

(1 SHEET)

EXPLANATION OF THE FIGURES.

In Fig 1. C, C is the second the succeeding or other Cylinder, R the Piston Rod _ L L is the bending Lever instead of the Beam (See Fig 3) _ N is the Connecting Rod, P is the Rod that is united at one end by a moveable Joint to the Piston Rod and is always nearly perpendicular, and at the other end by a moveable Joint to the Connecting Rod, and to the Direction Rod. D is this Direction Rod _ F.F. are two Friction wheels likewise (See Fig 4) (In Fig 2) C C is the Cylinder P is the Piston B.B. the Valve Boxes. V.V.V the Valves. _ O.O are openings for the Steam to pass in and out of the Boxes, or to and fro from the Cylinder _ T.T is a very thin conical Shell that receives the jets of Water that are employed in condensing the Steam _ W is a Pipe to carry off the hot Water _ A is a small Pipe through which the Air and uncondensed Steam are discharged _ E. is a Valve through which the said Air and hot Water are forced out when the Piston descends to the bottom _ F, is a Piece fixed to the Piston to fill up the Cavity where the Steam is condensed _ I, is the Injection Tube made to take in and out readily by having the two Bevel parts turned and ground like a Valve. The Cold Water injection is made in this Tube by means of the same forcing Pump that serves for feeding the Boiler with hot water and raising the said Water, one end serving for the Cold Water and is furnished with a loaded Valve and Air Vessels, and the other end serving for the hot Water, for this Purpose the Piston is made longer than the Stroke. In order to equalize the Power by a mechanical method I employ a bended Lever with three or three Pair, or Sets of Connecting and Guide or Direction-Rods for this Purpose only This Mechanism is seen in Fig 1. and that Proportion serves in case the Steam is dilated in that Cylinder, into six times the space it occupies in the preceeding Cylinder. For opening and shutting off the Communications as mentioned in all the foregoing Cases upon the above Principles I usually employ Valves and Valve Boxes that from the Mode of constructing them will always have an equal pressure from the Steam in two contrary Directions and consequently they will be moved with the greatest ease when loaded with the whole Pressure of the Steam. the said Valves are opened and shut in many cases by means of a revolving Motion for this and the method of condensing the Steam and discharging the air with other vapour that remains uncondensed. See Fig 2.



The enrolled drawing is not colored.

Malby & Sons lith.

LONDON: Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE
Printers to the Queen's most Excellent Majesty. 1854

be able to counteract any degree of pressure from the steam contained in the said vessels; the said pump is wrought by the engine or otherwise.

In witness whereof, I, the said John Dale, have hereunto set my hand and seal, this Eighteenth day of July, in the year of our Lord One thousand seven hundred and ninety-three.

JOHN (L.S.) DALE.

AND BE IT REMEMBERED, that on the same Eighteenth day of July, in the year above mentioned, the aforesaid John Dale came before our Lord the King in His Chancery, and acknowledged the Specification aforesaid, and all and everything therein contained, in form above written. And also the Specification aforesaid was stamped according to the tenor of the Statute in that case made and provided.

Inrolled the same Eighteenth day of July, in the year above written.

Jn° Spranger.

LONDON:
Printed by George Edward Eyre and William Spottiswoode,
Printers to the Queen's most Excellent Majesty. 1854.